(54) PIEZOELECTRIC PERCELAIN COMPOSITION

(57) Abstract:

PROBLEM TO BE SOLVED: To obtain a piezoelectric porcelain composition applicable for driving at high vibration frequency.

SOLUTION: Main component is expressed by a compositional formula $aPbZrO_3$-$bPbTiO_3$-$cPb(Mn_{1/3}Nb_{2/3})O_3$ (wherein $a+b+c=1$). The component range is on the line connecting the component points and in an area surrounded by these four component points which are W ($a=0.35$, $b=0.60$, $c=0.05$), X ($a=0.60$, $b=0.35$, $c=0.05$), Y ($a=0.25$, $b=0.50$, $c=0.25$) and Z ($a=0.55$, $b=0.20$, $c=0.25$). 0.1-0.5 wt.% La_2O_3 is contained as a subsidiary component in 100 wt.% of the main component.

JP 11-322423 A

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CLAIMS

[Claim(s)]
[Claim 1] A principal component is expressed with empirical formula aPbZrO3-bPbTiO3-cPb(Mn1/3Nb 2/3) O3 (however, a+b+c=1). The presentation range W (a= 0.35, b= 0.60, c= 0.05), X (a= 0.60, b= 0.35, c= 0.05), When it is expressed in the field surrounded by the line top which connects the forming point of Y (a= 0.25, b= 0.50, c= 0.25) and Z (a= 0.55, b= 0.20, c= 0.25), and these four points and a principal component is made into 100% by weight as an accessory constituent, La 2O3 -- 0.1 - 0.5wt% -- the piezoelectric-ceramics constituent characterized by containing.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the piezoelectric-ceramics constituent which has the efficient electric machine transfer characteristic with a wide range vibration level especially about the piezoelectric material suitable for a piezoelectric transformer, an electrostrictive actuator, an ultrasonic vibrator, etc.
[0002]
[Description of the Prior Art] As for the piezoelectric material which can transform electrical energy into mechanical oscillation energy, the application to a piezoelectric transformer, an electrostrictive actuator, an ultrasonic vibrator, etc. is made. Piezoelectric material reaches far and wide from a small mechanical output to a very big mechanical output to these application according to the application, and is efficient, and it is called for that electric-mechanical energy conversion is performed. While the device adapting piezoelectric material is put in practical use in recent years, the further increase of the mechanical output is searched for.
[0003] Therefore, on the occasion of conversion to the mechanical vibrational energy of electrical energy, it is necessary [it] to these application to control energy loss for piezoelectric material. Since generation of heat by internal energy loss arises in connection with an amplitude of operation or a vibration level becoming high, the amplitude which can be excited soon will reach threshold value, i.e., vibration level threshold value, and will cause dielectric breakdown of an ingredient further. V is expressed with a degree type when a vibration level is now made into the effectual velocity of vibration V computable from measurement of maximum tip amplitude xim of vibrator, and the resonance frequency fr of vibrator.
[0004] V=21/2, andpi-fr-xim ... (1)
[0005] However, when a vibration level was expressed by the velocity of vibration, with the conventional technique, there was a problem that the limitation of the velocity of vibration which can be used in comfort was low.

[0006]
[Problem(s) to be Solved by the Invention] Since the conventional ingredient served as a drive by the low velocity of vibration as described above, the application to the device with which a big mechanical output is demanded was difficult.
[0007] This invention aims at offering the piezoelectric-ceramics constituent which can also drive the high velocity of vibration.
[0008]
[Means for Solving the Problem] this invention person found out the presentation

range and additive range of a piezoelectric-ceramics ingredient which can be driven also with a high vibration level (rate).
[0009] Namely, as for this invention, a principal component is expressed with empirical formula aPbZrO3-bPbTiO3-cPb(Mn1/3Nb 2/3) O3 (however, a+b+c=1). The presentation range W (a= 0.35, b= 0.60, c= 0.05), X (a= 0.60, b= 0.35, c= 0.05), When it is expressed in the field surrounded by the line top which connects the forming point of Y (a= 0.25, b= 0.50, c= 0.25) and Z (a= 0.55, b= 0.20, c= 0.25), and these four points and a principal component is made into 100% by weight as an accessory constituent, La 2O3 -- 0.1 - 0.5wt% -- it is the piezoelectric-ceramics constituent characterized by containing.
[0010] The piezoelectric-ceramics ingredient which has the vibration level limitation Vmax higher than before by considering as the above-mentioned presentation range and above-mentioned additive range of this invention is obtained.
[0011]
[Embodiment of the Invention] The gestalt of operation of this invention is explained below.
[0012] As a start raw material which obtains the constituent of this invention, each powder of a lead oxide (PbO), a zirconium dioxide (ZrO2), titanium oxide (TiO2), manganese carbonate (MnCO3), niobium oxide (Nb 2O3), and a lanthanum trioxide (La 2O3) was used.
[0013] Specified quantity weighing capacity of each raw material powder was carried out, and temporary quenching of the mixed powder was carried out in 2-hour atmospheric air at 850 degrees C after wet blending by the ball mill. After grinding temporary-quenching powder, it binder-mixed and fabricated, and further, the debinder was carried out and it calcinated in 2-hour atmospheric air at 1200-1265 degrees C. Next, after cutting the obtained sintered compact and processing it into a 43x7x1mm rectangle plate, the silver electrode could be burned on both the principal planes that carry out phase opposite, 4kV [/mm] direct-current electric field were impressed among silicone oil at 100 degrees C for 15 minutes, and polarization processing was performed.
[0014] After polarization processing, room temperature neglect was carried out for 24 hours, the basic mode of the piezo-electric transversal-effect die-length direction vibration was excited, and the vibration level limitation was measured.

[0015] Temperature rise (difference of room temperature and temperature of vibrator) deltaT excited by internal energy loss of the vibrator made the vibration level (rate) limitation the velocity of vibration which becomes 20 degrees C by the thermometry in the joint of vibration of a piezoelectric transducer.
[0016] A measurement result is shown in Table 1. In Table 1, mol% shows PbZrO3 amount, PbTiO3 amount, and Pb(Mn1/3Nb 2/3) O3 amount. Moreover, it is shown that the sample which * described is a sample besides the generic claim of this invention.
[0017]
[Table 1]

試料 No.	PbZrO₃量 a	PbTiO₃量 b	Pb(Mn₁/₃Nb₂/₃)O₃量 c	La₂O₃量 (wt%)	振動レベル限界 (単位：m/s)
1 *	3 5	6 0	5	0	0.25
2	3 5	6 0	5	0.2	0.41
3	3 5	6 0	5	0.3	0.46
4 *	6 0	3 5	5	0	0.40
5	6 0	3 5	5	0.1	0.45
6	6 0	3 5	5	0.3	0.50
7 *	4 5	4 0	1 5	0	0.53
8	4 5	4 0	1 5	0.3	0.55
9	4 5	4 0	1 5	0.5	0.57
1 0 *	3 5	5 0	1 5	0	0.47
1 1	3 5	5 0	1 5	0.1	0.49
1 2	3 5	5 0	1 5	0.3	0.53
1 3	3 5	5 0	1 5	0.5	0.55
1 4 *	2 5	5 0	2 5	0	0.36
1 5	2 5	5 0	2 5	0.1	0.40
1 6	2 5	5 0	2 5	0.3	0.48
1 7	2 5	5 0	2 5	0.5	0.49
1 8 *	2 5	5 0	2 5	1.0	0.39
1 9 *	5 5	2 0	2 5	0	0.42
2 0	5 5	2 0	2 5	0.3	0.48
2 1	5 5	2 0	2 5	0.5	0.51

[0018] Next, based on Table 1, the reason which limited the rate of a compounding ratio of each compound (presentation ratio) is explained below. [0019] Since loss by internal friction accompanying movement of a ferroelectric domain wall is large when the amount c of Pb(Mn1/3Nb 2/3) O3 is less than [5mol%], a vibration level limitation is low. Moreover, if 25-mol% is exceeded, unusual appearances, such as pyrochlore, will generate and elastic loss will be caused. Moreover, if the rate of a compounding ratio of the amount a of PbZrO3 is made into the ratio besides a generic claim, since the capacity to transform electric energy into mechanical energy will fall extremely, a vibration level limitation becomes low. The amount b of PbTiO3 will be inevitably decided, if a and c are decided. 2OLa3 amount is desirable out of a generic claim by neither the fall of the effectiveness, nor change of the degree of sintering of an ingredient. Therefore, it is limited to presentation within the limits which that a vibration level limitation becomes larger than before charged.
[0020]
[Effect of the Invention] As explained above, according to this invention, the piezoelectric-ceramics constituent which can be driven also with the velocity of vibration conventionally higher than an ingredient or the large amplitude was able to be offered.
[0021] Therefore, it becomes applicable to the piezo-electric device vibrated with a high vibration level or the large amplitude, and industrial value is size.